$1.00

Simpson

INSTRUMENTS THAT STAY ACCURATE

OPERATOR'S MANUAL

MODEL 313 SERIES 3
SOLID STATE
VOLT-OHM-MILLIAMMETER

WARNING

For safe usage, it is essential that the operator read this manual carefully before using the instrument for any measurements.

SIMPSON ELECTRIC COMPANY

853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 697-2260
In Canada, Bach-Simpson, Ltd., London, Ontario

Warranty

SIMPSON ELECTRIC COMPANY warrants each instrument and other articles of equipment manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any instrument or other article of equipment which shall within 90 days after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products.

This warranty shall not apply to any instrument or other article of equipment which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service stations, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

Simpson
INSTRUMENTS THAT STAY ACCURATE

ELECTRIC COMPANY
853 Dundee Ave., Elgin, Illinois 60120 Phone: (312) 697-2260
IN CANADA: Bach-Simpson, Ltd., London, Ontario
IN ENGLAND: Bach-Simpson (U.K.) Limited, Wadebridge, Cornwall
IN INDIA: Ruttonsha-Simpson Private, Ltd., International House, Bombay-Agra Road, Vikhroli, Bombay

KATY INDUSTRIES
ELECTRICAL EQUIPMENT GROUP

OPERATOR'S MANUAL

MODEL 313 SERIES 3
SOLID STATE
VOLT-OHM-MILLIAMMETER

SIMPSON ELECTRIC COMPANY
853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 697-2260
In Canada, Bach-Simpson, Ltd., London, Ontario

Printed in U.S.A.
5C878 (123.03)

Part No. 5-118394

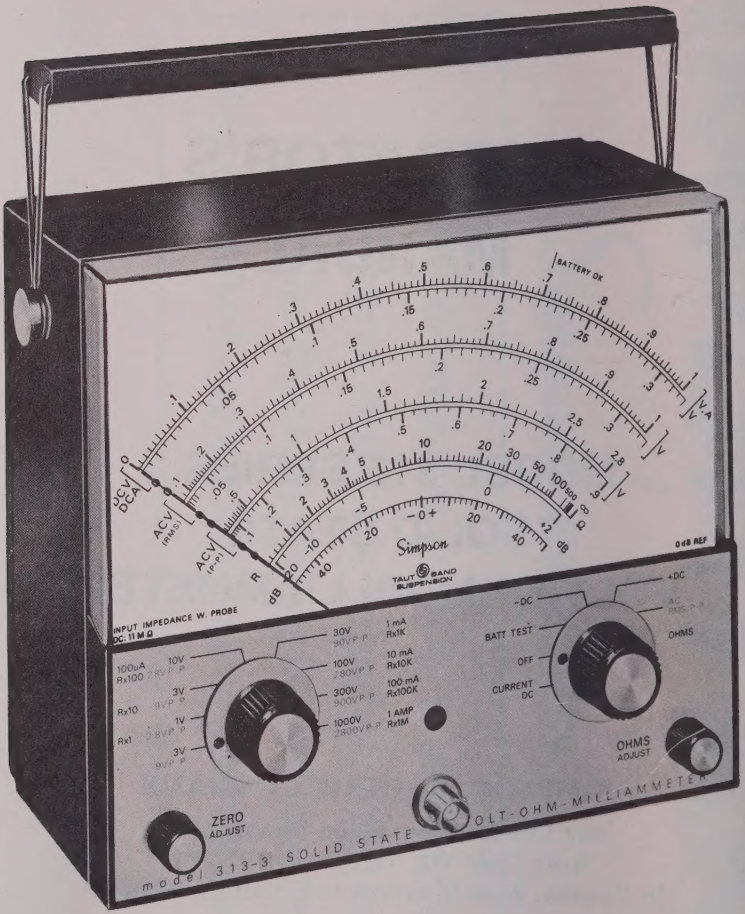


Figure 1-1. Simpson Model 313 Series 3, Solid State Volt-Ohm-Milliammeter

TABLE OF CONTENTS

SECTION I

Introduction 1-1

1.1 General 1-1
1.2 Accessories and Supplies 1-1
1.3 Technical Data 1-2

SECTION II

Installation 2-1

2.1 Unpacking and Inspection 2-1
2.2 Power Requirements 2-1
2.3 Installation 2-1

SECTION III

Controls, Connectors and Indicators 3-1

SECTION IV

Operation 4-1

4.1 Safety Precautions 4-1
4.2 Mechanical Zero Adjustment 4-3
4.3 Electrical Zero Adjustment 4-3
4.4 Measuring DC Voltages 4-3
4.5 Zero Center DC Voltages 4-4
4.6 Measuring AC Voltages, RMS and Peak-to-Peak 4-5
4.7 dB Measurement 4-7
4.8 Measuring Resistance 4-7
4.9 Measuring DC Current 4-9

SECTION V

Instrument Applications 5-1

5.1 General 5-1
5.2 Measuring Low Cathode and Transistor Base/Emitter Voltages 5-2
5.3 Measuring Plate Voltages 5-2
5.4 Phase Inverter and Phase Splitter Balance 5-2
5.5 Measuring Stage Gain 5-3
5.6 Measuring AGC Voltage 5-3
5.7 Measuring Oscillator Grid Bias 5-4
5.8 Discriminator Adjustment 5-4

5.9 FM Alignment 5-4
5.10 Measuring Non-Symmetrical Wave Signals 5-5
5.11 Forward and Reverse Rectifier Resistances 5-5
5.12 Coupling and By-Pass Capacitors 5-6

SECTION VI

Maintenance 6-1

6.1 General 6-1
6.2 Warranty 6-1
6.3 Shipping 6-1
6.4 Transit Setting 6-2
6.5 Case Removal 6-2
6.6 Battery Replacement 6-2
6.7 Calibration 6-4

SECTION VII

Accessory Probes 7-1

7.1 General 7-1
7.2 High Frequency Probe 7-1
7.3 DC High Voltage Probe 7-3

SECTION VIII

Ordering Information, Schematic, and Service Center Listing 8-1

LIST OF TABLES

1-1 Model 313-3 Technical Data 1-2
3-1 Controls, Connectors and Indicators 3-1
4-1 Resistance Measurements 4-8
8-1 Items Supplied With Instrument 8-1
8-2 Accessories 8-1
8-3 Replacement Parts 8-2

LIST OF ILLUSTRATIONS

1-1 Simpson Model 313 Series 3, Solid State Volt-Ohm-Milliammeter ii
3-1 Model 313-3 Front Panel 3-2
6-1 Instrument Sub-Assembly, Internal Adjustment Controls 6-3
7-1 High Frequency Probe 7-2
7-2 DC High Voltage Probe 7-4
8-1 Model 313-3 Schematic Diagram 8-4

WARNING

This Instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak and where a leakage current from that part to ground exceeds 0.5 milliampere, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C39.5.

NOTE: The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohm non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229-Series 2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC Leakage current, connect a 1500 ohm non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

SECTION I

INTRODUCTION

1.1 GENERAL

1.1.1 The Simpson Model 313 Series 3 (hereafter referred to as Model 313-3 or the Instrument) is a battery operated, all solid state Volt-Ohm-Milliammeter designed to measure a wide range of AC and DC voltages, DC current and resistance. It features a large 7½ inch, shock resistant, self-shielding, high performance, taut band meter. This meter achieves stable, reliable, easy-to-read readings, free from friction and having excellent accuracy and repeatability. Additional features are a mechanical power-on indicator, high input resistance, excellent frequency response, seven resistance ranges and 300 mV full scale AC and DC sensitivities.

1.1.2 The mechanical power-on indicator alerts the operator that battery power is being used but does not contribute to battery drain. The high input resistance and excellent frequency response allow the Instrument to be used for measurement of vacuum tubes as well as transistor circuits. The all solid state design and a careful choice of components assure good reliability and long battery life.

1.1.3 Its combination of features and optimized design and construction make the Model 313-3 a rugged instrument having the portability and versatility of a low impedance VOM, and the sensitivity and high impedance of a VTVM.

1.1.4 The Instrument is housed in a high impact black phenolic case, with an Adust-A-Vue type handle. A battery compartment cover is provided on the rear of the case to permit access to the batteries. The majority of the components are assembled on a single printed circuit board to achieve uniformity and simplify maintenance. The function selector switch has a BATT TEST position which permits the operator to conveniently test the electrical condition of the internal 9V battery.

1.1.5 The Simpson Model 313-3 is supplied with a slim, shielded test probe (refer to Table 3-1, item 7). This probe is used with the Instrument to extend its basic measurement capabilities.

1.2 ACCESSORIES AND SUPPLIES

All items required for the operation of the Instrument are furnished with the Instrument, and listed in Section VIII, Table 8-1. Available accessory probes are covered in Section VII, and Table 8-2.

1.3 TECHNICAL DATA

Table 1-1 lists the technical specifications for the Simpson Model 313-3 Solid State Volt-Ohm-Milliammeter.

Table 1-1. Model 313-3 Technical Data

1. DC Voltage:	
Ranges (eight):	0 to 0.3, 1, 3, 10, 30, 100, 300 and 1,000 volts
Accuracy:	±3% of full scale
Input Resistance:	11 Megohms (with probe switch in the DC position)
Overload Protection (no AC voltage present):	0.3V range: 90V 1.0V range: 300V All other ranges: 1000V
2. AC Voltage:	
a. Ranges, RMS, (eight):	0 to 0.3, 1, 3, 10, 30, 100, 300 and 1,000 volts
b. Ranges, peak-to-peak (eight):	.9, 2.8, 9, 28, 90, 280, 900 and 2800 volts
c. Accuracy:	±3% of full scale
d. Input Resistance:	10 megohms (with probe switch in the AC position)

e. Frequency Response (probe switch set to AC/OHMS/mA position):	0.3, 1.0, 3.0V Ranges: ±0.5 dB from 20 Hz to 100 kHz 10, 30, 100V Ranges: ±0.5 dB from 20 Hz to 20 kHz 300, 1000V Ranges: flat at power line frequencies
f. Overload Protection (no DC voltage present):	.3V range: 60V 1V range: 200V 3V range: 600V All other ranges: 1000V

3. DC Current:

a. Ranges (five):	0 to 0.1, 1, 10 and 100mA, and 0 to 1 amp
b. Accuracy:	±3% of full scale
c. Voltage Drop:	0.1 volt

4. Resistance:

a. Ranges:	Maximum Test Current (nominal)
Rx1 (0-500 ohms)	150 mA
Rx10 (0-5,000 ohms)	15 mA
Rx100 (0-50,000 ohms)	1.5 mA
Rx1K (0-500,000 ohms)	150 μA
Rx10K (0-5 megohms)	15 μA
Rx100K (0-50 megohms)	1.5 μA
Rx1M (0-500 megohms)	.15 μA
b. Ohms Center:	10 ohms (Rx1 range)
c. Accuracy:	±3° of arc
d. Maximum Open Circuit Voltage:	1.5 VDC

5. Test Leads:	A single test probe assembly is supplied. It consists of a probe body, ground lead, shield cable, and a BNC connector. The probe contains a 1 megohm isolation resistor which is switched in for DC voltage measurements and allows the measurement of DC voltages without capacitive loading of the AC signals present. Refer to Table 3-1, Item 7.
6. Operating Temperature Range:	10°C to 40°C
7. Reference Conditions:	23°C ±2°C, 30% to 60% relative humidity
8. Power Supply:	One 9-volt battery, NEDA type 1600 One 1.5-volt battery, D size cell, NEDA 13 series
9. Overall Dimensions:	7-3/4 x 6-3/4 x 3-3/4
10. Weight:	4.5 pounds

SECTION II

INSTALLATION

2.1 UNPACKING AND INSPECTION

2.1.1 Examine the shipping carton for any sign of damage prior to unpacking. If there is none, inspect the Instrument and packing material for obvious damage from mechanical shock, water leakage, or other causes. The Instrument should be physically free of marks or scratches, and the electrical performance should be checked as soon as possible. If there is any indication of damage, file a complaint with the carrier immediately. Also check that all items are included (refer to Table 8-1).

2.1.2 The shipping carton and packing materials should be saved for future storing or shipping of the Instrument.

2.2 POWER REQUIREMENTS

2.2.1 The Simpson Model 313-3 is powered by two batteries supplied with the Instrument. Refer to Table 1-1, item 8 for specifications.

2.2.2 The batteries are packaged separately in the shipping carton. For installation instructions refer to paragraph 6.6.

2.3 INSTALLATION

The Instrument can be used in the horizontal, inclined, or vertical positions. The specifications shown in Table 1-1 are with the Instrument in the horizontal plane.

SECTION III

CONTROLS, CONNECTORS AND INDICATORS

Table 3-1 describes all the controls, connectors, and indicators of the Model 313-3 Solid State Volt-Ohm-Milliammeter. Become thoroughly familiar with each of these controls, prior to operating the Instrument for the first time.

Table 3-1. Controls, Connectors and Indicators

1. Range Selector Switch:	This is an eight position rotary switch: a. Each of the eight positions has black markings which correspond to the full scale values of the DC and AC RMS voltage ranges and red markings which correspond to the full scale value of the AC peak-to- peak voltage ranges. b. Seven of the eight positions have black markings which correspond to the resistance ranges. c. Five of the eight positions have black markings which correspond to the full scale value of the current ranges.
2. Function Selector Switch:	This is a seven position rotary switch. The positions marked CURRENT DC, −DC, +DC, AC RMS/P-P, and OHMS are used in conjunction with the applicable range selector switch positions. The positions marked OFF and BATT TEST are independent of the range selector switch settings.

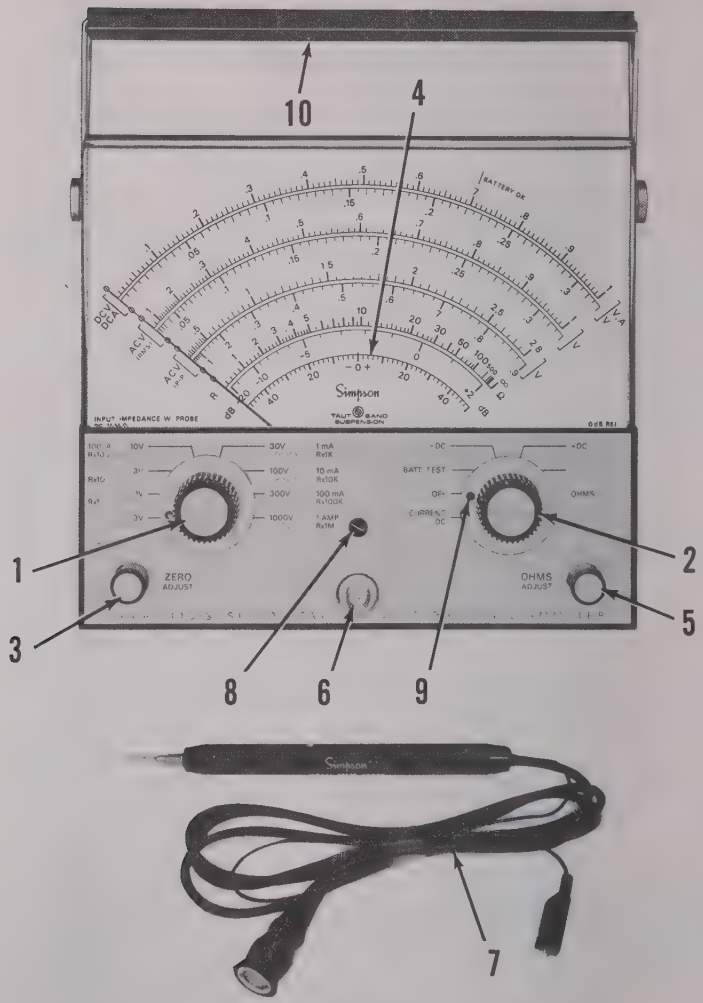


Figure 3-1. Model 313-3 Front Panel

3. ZERO ADJUST Control: This control is used to set the electrical zero (0) of the Instrument, when the Instrument is used for −DC or +DC voltage, AC RMS or peak-to-peak voltage, or OHMS measurements. The electrical zero (0) should always be checked and adjusted to ensure accurate readings.
NOTE: When using the Model 313-3 to measure resistances, it is very important to check and reset zero (0) each time the range is changed.

4. Zero (0) Center Scale: The Model 313-3 is provided with a zero (0) center scale (located immediately below the red dB scale), for convenient alignment of discriminator circuits. When using the Instrument for this purpose, the function selector switch is set to −DC or +DC and the ZERO ADJUST control is used to set the pointer of the Instrument on the (0) mark of the scale.

5. OHMS ADJUST Control: This control is marked OHMS ADJUST and is used to set the pointer indication on the full scale mark "∞" (infinity) before a resistance measurement is made.

6. Input Connector: This is a BNC type connector which provides for quick (push-in and twist) connection of the test probe assembly. The outside shell of the connector is insulated at circuit ground potential.

WARNING

For maximum safety, do not touch the input connector, the Instrument or the probe while making measurements.

7. Test Probe:

The Model 313-3 is supplied with a test probe assembly consisting of a probe, a 4-foot coaxial cable and a BNC connector. The center conductor of the coaxial cable is connected to the tip of the probe and the high side of the Model 313-3 input circuit (through the input connector). The outer conductor of the coaxial cable is connected to the ground lead (which terminates in an alligator clip), and to the outer shell of the input (BNC) connector. The probe contains a two-position switch marked DC and AC/OHMS/mA.

a. When the switch is in the DC position, a 1 megohm resistor is connected in series with the probe tip. This resistor isolates the capacity of the test probe cable, and the Instrument input from the circuit under test, thereby increasing the DC measurement capability in the presence of AC. Without this resistor, excessive AC loading could occur, which could affect the DC voltage under test and result in an erroneous measurement.

NOTE: The DC calibration of the Instrument is made with the probe connected. If the Model 313-3 is used for DC measurements without the probe, a 1 megohm resistor must be connected in series with the input test lead.

b. When the switch is in the AC/OHMS/mA position, the probe tip is connected directly to the input of the Instrument.

8. Meter Zero Adjustment Screw:

This screw is used to set the mechanical zero of the Instrument. The adjustment is accomplished by inserting a screwdriver

into the slot of the adjustment screw (located in the center of the front panel immediately below the dial), and turning the screw clockwise, or counterclockwise, as desired until the pointer rests at zero (0). The screw is then turned back slightly, approximately 1/16 of an inch, to relieve the pressure on the internal adjusting mechanism. The adjustment is performed with the circuit selector switch in the OFF position and the Instrument in the plane in which it will be used.

9. Mechanical Power Off-On Indicator: This indicator replaces the conventional pilot lamp, and consists of a window in the skirt of the function selector switch knob through which a black color shows when the switch is in the OFF position, and a red color in all other positions (to indicate on). Red in the window alerts the operator that power is being drawn from the internal battery.

10. Adjust-A-Vue Handle: A black plastic molded handle is attached to each side of the case with chrome plated holders and studs. The handle may be used to position the Instrument at a convenient angle for easy viewing on a work bench. The Instrument can also be used in a vertical or horizontal position.

SECTION IV

OPERATION

WARNING

This Instrument is designed to prevent accidental shock when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely prior to making any measurements. Failure to do so can result in a serious or fatal accident.

This section of the manual contains information required to use and operate the Instrument in a safe and proper manner.

4.1 SAFETY PRECAUTIONS

4.1.1 The Simpson 313-3 is designed to be used only by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury. Refer to SHOCK HAZARD definition on page v.

4.1.2 Do not work alone when making measurements where a shock hazard can exist. Notify another person that you are, or intend to make such measurements.

4.1.3 Remember, voltages might appear unexpectedly in defective equipment. An open bleeder resistor can result in a capacitor's retaining a dangerous charge. Remove all power and discharge all capacitors in the circuit being measured and remove all power from the Simpson 313-3 before making connections or disconnections. The Instrument itself is well protected against electrical overload, as noted throughout Section 1.3. However, the above

precautions are wise even in the laboratory, and especially in field usage of the Instrument where many strange or unknown safety hazards might prevail.

4.1.4 Locate all voltage sources and accessibility paths prior to making any measurement or connections.

4.1.5 For your own safety, inspect the test leads for cracks, breaks or crazes in the insulation prods and connectors before each use. If any defects exist, destroy and replace the defective item(s) immediately.

4.1.6 Do not make measurements in a circuit where corona is present. Corona can be identified by a pale-blue color emanating from sharp metal points in the circuit or a buzzing sound, or the odor of ozone. In rare instances, such as around germicidal lamps, ozone might be generated as a normal function. Ordinarily, the presence of ozone indicates presence of high voltage, and probably a malfunction of some kind.

4.1.7 Hands, shoes, floor and workbench must be dry. Avoid making measurements under humid, damp, or other environmental conditions that could affect the dielectric withstanding voltage of the test leads or the Instrument.

4.1.8 For maximum safety, do not touch test leads, circuit, or Instrument while power is applied to the circuit being measured.

4.1.9 Use extreme caution when making measurements in an rf circuit where a dangerous combination of voltages could be present, such as in a modulated rf amplifier.

4.1.10 Do not use test leads which differ from those originally furnished with the Instrument.

4.1.11 Before the Instrument is used for measurements on AC powered equipment, make sure that the "third wire" on all AC power cords is connected to an earth or power line ground.

4.1.12 Do not float the COMMON terminal more than 600 volts (DC plus AC peak) with respect to the power line ground.

4.1.13 Always connect the ground lead of the test probe to the

common (low potential) side of the circuit under test. Check that no potential exists between the common side of the circuit under test and power line ground.

4.1.14 Do not come into contact with any object which could provide a current path to the common side of the circuit under test or power line ground. Always stand on a dry insulating surface capable of withstanding the voltage being measured or that could be encountered.

4.2 MECHANICAL ZERO ADJUSTMENT

With the function selector switch in the OFF position, check that the pointer of the Instrument is at zero (0). If the pointer is off zero, adjust it as described in Table 3-1, Item 8.

4.3 ELECTRICAL ZERO ADJUSTMENT

Turn the function selector and range switches to the function and range that will be used. Connect the tip of the test probe and ground lead together. Rotate the ZERO ADJUST Control until the Instrument pointer is directly over the zero (0) mark at the left side of the scale.

4.4 MEASURING DC VOLTAGES

WARNING

Prior to making measurements, review the Safety Precautions listed in Paragraph 4.1.

4.4.1 After the mechanical and electrical zero adjustments have been properly performed (paragraphs 4.2 and 4.3), proceed as follows:

a. Remove all power from the circuit being measured and discharge all capacitors.

b. Turn the function selector switch to the −DC or +DC position, depending on the polarity of the voltage to be measured.

c. When measuring an unknown voltage, set the range selector switch fully clockwise (highest voltage range).

d. Connect the ground lead of the tester to the common point of the circuit under test.

e. Set the test probe switch to the DC position, and connect the probe tip to the circuit under test. Be careful not to contact adjacent points.

f. Apply power to the circuit under test. For maximum safety, do not touch the probe, ground lead, circuit, or Instrument while power is applied.

g. Read the value of the voltage being measured on the appropriate DC meter scale. For the 0.3, 3.0, 30, 300 DC volt ranges, use the black arc marked V. For the 1.0, 10, 100, 1,000 volt ranges, use the black arc marked V. A.

h. Remove all power from the circuit under test, discharge all capacitors, and disconnect the probe tip and ground lead from the circuit under test.

i. Rotate the range selector switch to the 1,000V position.

4.5 ZERO CENTER DC VOLTAGES

WARNING

Prior to making measurements, review the Safety Precautions listed in Paragraph 4.1.

a. Set function selector switch at +DC.

b. Set the test probe switch to the DC position and connect the test probe tip and ground lead together.

c. Rotate the ZERO ADJUST control until the meter pointer rests over the zero mark on the zero center scale (bottom scale).

NOTE: This control should be capable of setting the pointer beyond the center zero mark. If not, the internal zero adjustment control (R26) may require adjustment (see Figure 6-1).

d. Set the range selector switch to a range which is at least twice the value of the voltage being measured.

e. Remove all power from the circuit under test and discharge all capacitors.

f. Connect the probe tip and ground lead to the circuit under test. Be careful not to contact adjacent points.

g. Apply power to the circuit being measured. For maximum safety, do not touch the probe, ground lead, circuit or Instrument while power is applied.

h. Observe the Instrument pointer indication on the zero center arc. Positive voltages will make the pointer deflect to the right of the center zero mark, and negative voltages to the left. Each side of the scale (from zero center) represents one-half of the range being used. For example, when the 10 volt range is being used, the left half of the scale represents 0 to −5 volts, the right half 0 to +5 volts, and each minor division 0.2 volt.

i. Remove all power from the circuit being measured, discharge all capacitors, and disconnect the probe and ground lead.

j. Rotate the range selector switch to the 1,000V position.

4.6 MEASURING AC VOLTAGES, RMS AND PEAK-TO-PEAK

WARNING

Prior to making measurements, review the Safety Precautions listed in Paragraph 4.1.

4.6.1 The Model 313-3 employs a peak-to-peak type detector, and the meter AC scales are calibrated in both rms and peak-to-peak values. The rms markings are based on a true sinusoidal signal. Therefore, when other than sinusoidal signals are measured, the accuracy of the rms indication will be affected.

4.6.2 The procedure for making AC voltage measurements is as follows:

a. Set the function selector switch to the AC RMS/P-P position.

b. Set the range selector switch to the desired range.

c. Remove all power from the circuit being measured and discharge all capacitors.

d. Connect the ground lead of the probe to the chassis or common point of the circuit under test.

e. Set the test probe switch to the AC/OHMS/mA position. Connect the tip of the probe to the circuit under test. Be careful not to contact adjacent points.

f. Apply power to the circuit being measured. For maximum safety, do not touch the probe, ground lead, circuit or Instrument while power is applied.

g. Observe the Instrument's indication. The pointer will indicate AC voltages on two arcs, AC (rms) and P-P (peak-to-peak). Both values are valid when the input waveshape being measured is a sine wave. Only the peak-to-peak value applies when the input waveshape is not a sine wave.

NOTE: For range selector switch positions .3V, 3V, 30V, and 300V, use the .316 volt full scale arc for rms readings; and the .9-volt full scale arc for peak-to-peak readings. For range selector switch positions 1V, 10V, 100V, and 1000V, use the 1-volt full scale arc for rms readings; and the 2.8-volts full scale arc for peak-to-peak readings.

h. When measurement is completed, remove all power from the circuit under test, and discharge all capacitors. Then disconnect the test probe and ground lead from the circuit under test.

i. Rotate the range selector switch to the 1000V position.

4.7 dB MEASUREMENT

WARNING

Prior to making measurements, review the Safety Precautions listed in Paragraph 4.1.

4.7.1 The Model 313-3 has a dB scale which can be used to determine power levels. The dB markings are based on zero (0) dB equals 1 mW across 600 ohms. The dB measurement is accomplished, using the same procedure described in paragraph 4.6 for measuring AC voltages. Each position of the range selector switch corresponds to a 10 dB step. Therefore, using 0 dBm = 1mW in 600 ohms, and the 1 volt range as a reference point; the actual dB value is obtained by adding 10 dB to the dB scale indication for every clockwise position of the range switch, and subtracting 10 dB for the 0.3V range. For example, if the range switch is in the 3V position and the dB indication is −10, then the actual dB value is 0 dB.

4.8 MEASURING RESISTANCE

a. Turn the function selector switch to the OHMS position.

b. Set the range selector switch to the range desired.

c. Set the probe switch to AC/OHMS/mA.

d. Connect the probe tip to the ground lead clip and, if necessary, rotate the ZERO ADJUST control to obtain a zero (0) indication on the ohms scale of the meter.

e. Disconnect the ground lead clip from the probe tip. The meter pointer should deflect to full scale (infinity, ∞). If it doesn't, rotate the OHMS ADJUST control until a full scale indication is obtained. If the pointer cannot be brought up to full scale, the 1.5V battery must be replaced (see Section VI, paragraph 6.6).

f. If the resistance being measured is connected into a circuit, be sure that all power is removed from the circuit and all capacitors are discharged. Also, prior to making the measurement, check for resistance paths other than the resistance being measured. These paths can result in a measured value which is lower than the actual value of the resistance being measured.

g. Connect the probe tip and ground lead to the resistance being measured. Be careful not to contact adjacent points.

h. Read the pointer indication on the arc marked R. Multiply the reading by the value indicated on the range selector switch position. K stands for 1,000; M stands for 1,000,000. The result will be resistance in ohms (refer to Table 4-1).

Table 4-1. Resistance Measurements

RANGE SELECTOR SWITCH POSITION		MULTIPLY OHMS INDICATION BY
R x 1	(0 to 500 ohm range)	Read directly
R x 10	(0 to 5k ohm range)	10
R x 100	(0 to 50k ohm range)	100
R x 1k	(0 to 500k ohm range)	1,000
R x 10k	(0 to 5 Meg. ohm range)	10,000
R x 100k	(0 to 50 Meg. ohm range)	100,000
R x 1M	(0 to 500 Meg. ohm range)	1,000,000

i. On all resistance ranges of the Model 313-3, the probe tip has a positive (+) polarity, in reference to the ground test lead. This must be remembered, particularly when checking components which are polarity sensitive, such as semiconductors.

j. Disconnect the probe tip and ground lead.

k. If no additional resistance measurements are required, rotate the function selector switch to any voltage position, and the range selector switch to the 1000V position. These switch settings avoid the possibility of accidentally applying voltage to the resistance circuits of the Instrument.

4.9 MEASURING DC CURRENT

WARNING

Prior to making measurements, review the Safety Precautions listed in Paragraph 4.1.

4.9.1 Set the function selector switch to CURRENT DC.

4.9.2 Set the range selector switch to the range desired.

NOTE: For better accuracy select the range which will give the nearest to full scale indication.

4.9.3 Remove all power from the circuit being measured and discharge all capacitors.

4.9.4 Open the circuit in which the current is to be measured. Connect the ground lead of the probe to the negative side of the circuit, and the tip of the probe to the positive side of the circuit.

CAUTION

Make certain the Model 313-3 is not connected across a low impedance voltage source which can result in a current through the Instrument in excess of the range position marking. Failure to do so can damage the Instrument.

4.9.5 Apply power to the circuit under test. For maximum safety, do not touch the probe, ground lead, circuit or Instrument.

4.9.6 Read the current directly on the 0 to 1 black V.A arc.

NOTE: Locate the decimal point in accordance with the range selected. For example, if the 10 mA range is used, and the pointer indication is .8 then the value of the current under test is 8 mA.

4.9.7 Remove all power from the circuit being measured and discharge all capacitors.

4.9.8 Disconnect the probe tip and ground lead, and reconnect the circuit which was originally opened.

4.9.9 If no additional current measurements are required, rotate the function selector switch to a voltage position, and the range selector switch to the 1000V position. These switch settings avoid the possibility of accidentally applying voltage to the current circuits, which can damage the internal shunts.

SECTION V

INSTRUMENT APPLICATIONS

5.1 GENERAL

WARNING

Whenever the Model 313-3 is used for any of the following applications, always observe the precautions and procedures covered in Paragraph 4.1 and the appropriate measurement paragraphs for the application.

5.1.1 The Model 313-3 is designed to measure a wide range of AC and DC voltages, DC current, and resistances. Its high input

resistance and wide frequency range permit this tester to be used where a voltmeter of lower resistance, or narrower frequency range would excessively load the circuit under test. Due to the excellent sensitivity of the Instrument and the large meter scale, the operator can easily measure AC and DC voltages as low as 10 millivolts.

5.1.2 In the DC Mode, the Model 313-3 will measure voltage, current and resistance. Seven resistance ranges make it possible to measure the low resistances of conductors, as well as the high resistance of insulators.

5.1.3 In the AC Mode, both rms and peak-to-peak voltages can be measured. On the 0.3 through 100 volt ranges, useful measurements up to 1 MHz are possible. The following paragraphs cover some of the applications for the Model 313-3.

5.2 MEASURING CATHODE AND TRANSISTOR BASE/EMITTER VOLTAGES

Bias voltages of input stages (IF amplifiers, special type feedback amplifiers, and transistorized circuits), are usually very low. The low DC ranges and the resolution provided by the large meter dial of the Model 313-3, will permit accurate measurements of these voltages. Furthermore, the high input resistance of the Instrument minimizes loading effects.

5.3 MEASURING PLATE VOLTAGES

Vacuum tube circuits generally employ high value plate-load resistors. As such, using the conventional low resistance passive voltmeter will result in an error due to circuit loading by the measuring instrument. Such voltages however, can be measured quite accurately by the Model 313-3 with minimal disturbance of the circuit under test.

5.4 PHASE INVERTER AND PHASE SPLITTER BALANCE

5.4.1 Phase inverter circuits may be checked for balance in the following manner:

a. With an audio generator, apply an input voltage to the grids of the circuit.

b. Using the lower AC ranges of Model 313-3, measure the input voltage at the grids, and then, the output voltages at the plates. The high input resistance of the Instrument will permit these inverter circuit measurements without excessively loading the circuit. Compare the two values indicated for balance.

5.4.2 To measure the balance of a phase splitter circuit, proceed in the following manner:

a. Apply an audio frequency signal (voltage) between the grid and ground of the phase splitter.

b Using the Model 313-3, measure output voltage at the plate and the cathode of the vacuum tube. Compare the two readings for balance.

5.5 MEASURING STAGE GAIN

The stage gain of a vacuum tube or transistorized amplifier may be determined using Model 313-3.

a. Apply a voltage from a signal generator to the input of the amplifier. Measure the voltage applied.

b. Now measure the output voltage of the amplifier. The ratio of the output voltage to the input voltage is the gain of the amplifier stage.

5.6 MEASURING AGC VOLTAGE

Automatic Gain Control circuits develop low value voltages across a high resistance circuit. Consequently, a low resistance, placed in parallel with the AGC circuits will reduce (shunting effect) these voltages. For this reason, a voltmeter with a high input resistance and sensitive DC voltage ranges (such as Model 313-3), must be used to make these measurements.

5.7 MEASURING OSCILLATOR GRID BIAS

The negative voltage developed at the grid of an oscillator, can be measured easily and accurately with the Model 313-3, using one of the DC ranges. When the circuit is oscillating, it develops a negative DC voltage at its grid. The amplitude of this voltage is related to the output voltage of the oscillator; thus, by noting the negative bias at the grid of the oscillator, circuit operation can be verified throughout its frequency tuning range.

5.8 DISCRIMINATOR ADJUSTMENT

The bottom scale on Model 313-3 is used for discriminator adjustment. The procedure is as follows:

a. Set the function selector switch to +DC.

b. Set the range selector switch to the lowest range.

c. Short the ground lead to the tip of the test probe and rotate the ZERO ADJUST control until the pointer is directly over the zero (0) indicator line, in the center of the scale.

d. Connect the Model 313-3 probe and ground lead across the discriminator load resistors and adjust the discriminator coils for a zero center indication.

NOTE: If the discriminator is unbalanced, the pointer will deflect left or right of zero center.

5.9 FM ALIGNMENT

NOTE: Always follow the manufacturer's instructions for the receiver being aligned.

a. Connect the Model 313-3 across the first limiter grid leak resistor in an FM circuit.

b. Then, with the appropriate input signals applied to the receiver, adjust the tuned circuits for a maximum indication on Model 313-3. A maximum reading indicates the circuit is aligned.

5.10 MEASURING NON-SYMMETRICAL WAVE SIGNALS

The peak-to-peak responding circuit of the Model 313-3 is very useful for troubleshooting TV receivers and other devices which contain complex waveforms. Manufacturers of television sets generally specify the peak-to-peak values of complex, or non-symmetrical waveforms on their schematic diagrams. Those voltages can be read directly on the red P-P scales of the Instrument.

5.11 FORWARD AND REVERSE RECTIFIER RESISTANCES

CAUTION

When measuring the resistance of semiconductors do not exceed their current, or voltage ratings. The open circuit test voltage and maximum test current supplied by the ohmmeter circuits are covered in Table 1-1, item 4.

5.11.1 The resistance of copper oxide, germanium, silicon, and selenium rectifiers is dependent upon the polarity of the ohmmeter connections. Thus, the resistance is low with a forward bias polarity connection, and quite high with a reverse bias polarity connection. The ohms function of Model 313-3 can be used to determine the resistances for each polarity condition.

5.11.2 A forward bias polarity connection exists when the tip of the test probe is connected to the anode (P material of a semiconductor) and the ground lead is connected to the cathode (N material of a semiconductor) of a diode. The resistance measured is called the forward bias resistance.

NOTE: Typically, the forward bias resistance will be several hundred ohms (Rx100 range) for a germanium diode, and approximately 10 ohms for a silicon diode (Rx1 range).

CAUTION

Do not use the Rx1 or Rx10 range when checking germanium diodes.

5.11.3 A reverse bias polarity connection exists when the tip of the test probe is connected to the cathode and the ground lead to the anode of a diode. The resistance measured is called the reverse bias resistance.

NOTE: Typically, the reverse bias resistance will measure greater than 1 megohm (Rx10K range) for a germanium diode and greater than 100 megohms for a silicon diode (Rx1M range).

5.11.4 Forward and reverse bias resistance measurements can be used to check semiconductors in or out of circuit, by checking whether a rectifier (diode) or transistor junction is shorted. If both the forward and reverse bias resistance of a semiconductor diode measure low, a shorted junction is indicated. If both measure high, an open diode junction is indicated.

5.11.5 Forward and reverse bias resistance measurements can also be used to determine the anode and cathode leads of an unmarked diode:

a. The polarity of the probe tip of the Model 313-3 is positive with respect to the ground lead.

b. Therefore, the polarity connection which gives a low resistance measurement, will have the probe tip connected to the anode of the diode under test. Similarly, the polarity connection which gives a high resistance measurement, will have the probe tip connected to the cathode of the diode under test.

5.12 COUPLING AND BY-PASS CAPACITORS

5.12.1 RC-coupled vacuum tube circuits: One end of the capacitor is usually connected to the positive plate potential. The other end of the capacitor is connected to the grid of the following stage. Using the Model 313-3, the condition of the coupling capacitor can be checked while wired into the circuit:

a. With the tube of the following stage in the circuit, measure the voltage across the grid resistor. If the Model 313-3 shows a positive voltage at the grid (with respect to ground), with the tube in or out of the circuit, the coupling capacitor is leaky. If, however, the voltage at the grid is positive only when the tube is in the circuit, then the tube is gassy.

b. To identify an open coupling capacitor: Set the Model 313-3 to measure AC volts at each side of the coupling capacitor while it is in the circuit. With a signal applied to the input side, an open capacitor will show a normal or high voltage in the input side, but little or no voltage at the output. A good coupling capacitor will typically show the same voltage (within 20% on either side of the capacitor).

c. In the case of a by-pass capacitor, an open capacitor is indicated by a higher than normal AC voltage, and a shorted capacitor can be detected by a resistance measurement.

NOTE: In some circuits, an out-of-circuit capacitor check is required.

5.12.2 To identify a shorted or open capacitor out of circuit: Set the function selector switch of Model 313-3 to OHMS position. Use a high range setting for this check (medium range when checking electrolytics, and observe polarities) and proceed as follows:

a. For a good capacitor, the instrument pointer will initially deflect (or kick) toward the low end of the Ohms scale; then, increase in ohmic value (toward the high end of the ohms scale), indicating the capacitor is charging.

b. A steady low reading (zero or near zero ohms) indicates a shorted capacitor.

NOTE: If a repeat measurement is made, the capacitor must be first discharged, or the probe and ground lead connections reversed.

SECTION VI

MAINTENANCE

6.1 GENERAL

WARNING

This Instrument contains internal voltages that constitute a SHOCK HAZARD. For repairs or adjustments refer to a Simpson Authorized Service Center.

Models 2850 and 2851 are carefully designed and constructed with high quality components. Through proper care and operation, as outlined in this manual, you can expect a long, useful service life from this Instrument.

6.2 WARRANTY

The Simpson Electric Company warranty policy is printed on the inside front cover of this manual. Read it carefully prior to requesting a warranty repair.

NOTE: For assistance of any kind, including help with the Instrument under warranty, contact your nearest Authorized Service Center for instructions. These are listed on the last pages of the manual. If you wish to contact the factory directly, give full details of the difficulty and include the Instrument Model Number, Serial Number, and date of purchase. Service or shipping instructions will be promptly sent to you. There will be no charge for repair of the Instrument under warranty beyond one-way transportation charges. If an estimate of charges for non-warranty or other service work is required, a maximum charge estimate will be quoted. This charge will not be exceeded without your prior approval.

6.3 SHIPPING

Pack the Instrument carefully and ship it prepaid to the destination indicated. Insure the shipment.

6.4 TRANSIT SETTING

When the Instrument is not in use, set the function selector switch to the OFF position. This will not only extend battery life, but also shunts the meter to dampen it and prevent unnecessary pointer movement during transit.

6.5 CASE REMOVAL

6.5.1 The Instrument (see Figure 6-1), has been designed to provide quick and easy access to the interior components for replacement of parts and perform necessary adjustment.

6.5.2 To remove the Instrument from its case, first remove the three screws holding the battery compartment cover and then remove the four screws at the rear of the case. Now, the entire Instrument sub-assembly (chassis, printed circuit, etc.) can be slipped out of the case as one unit.

6.5.3 To re-install the Instrument into its case, use the reverse procedure.

6.6 BATTERY REPLACEMENT

6.6.1 The Model 313-3 requires one 9-volt battery NEDA type 1600 and one 1.5 volt "D" size cell NEDA type 13.

6.6.2 The 9-volt battery is used to supply power for the AC amplifier and the FET bridge circuit. To check the 9-volt battery, set the circuit selector switch to the BATT TEST position. Observe the meter pointer indication: If pointer is below the BATTERY OK indicator line, replace the battery (refer to paragraph 6.6.4 below).

6.6.3 The 1.5-volt battery is used to supply current for resistance measurements. If it is not possible to bring the pointer indication to full scale for any of the resistance ranges, replace the 1.5-volt battery (refer to paragraph 6.6.4 below).

6.6.4 Remove the three screws holding the battery compartment cover (at the rear of the case) and then remove the cover.

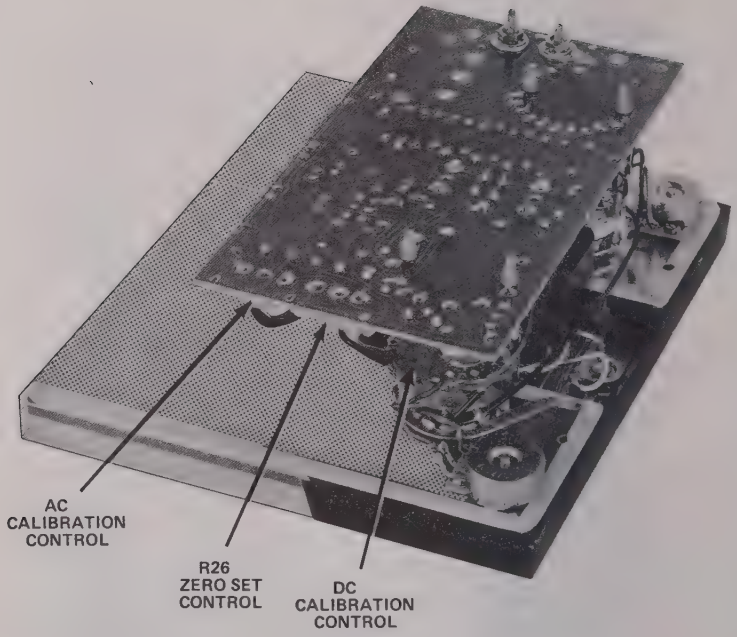


Figure 6-1. Instrument Sub-Assembly, Internal Adjustment Controls

6.6.5 The 9-volt battery is located in the left side of the compartment as viewed from the rear. Remove the battery retainer spring (wire clip) by gripping the outward portion and pulling it from the holder. The battery can now be removed and the battery lead snap-on connectors disconnected. To install a replacement battery, reverse the above procedure. The connectors are polarized to prevent incorrect polarity connections.

6.6.6 The 1.5-volt size D cell is located at the right side of the compartment. Remove it from its holder and install (push in) the replacement battery. The polarity of this battery can be reversed, so make certain the positive terminal is pointing to the right. Polarity signs are located on the back of the compartment next to the battery holder.

6.7 CALIBRATION

6.7.1 General

Since the electronics of the Model 313-3 are completely solid state, a high degree of reliability is inherent in its design. The Instrument will, therefore, operate satisfactorily for long periods without recalibration. To check calibration, proceed as follows:

NOTE: Before recalibration of the Model 313-3, make certain the 9-volt battery is in good condition.

6.7.2 DC Volts Calibration

a. With the function selector switch set to the OFF position, check the mechanical zero adjustment (refer to paragraph 4.2).

b. Rotate the function selector switch to the BATT position. Make sure the pointer deflects to the right of the indicator line marked BATTERY OK.

c. Rotate the function selector switch to the −DC position. Check and set electrical zero (refer to paragraph 4.3).

d. Rotate the function selector switch to +DC position. The pointer should still be at zero. Next, set the switch on the test probe to the DC position.

e. Set the range selector switch to the .3V position.

f. Connect the ground lead of Model 313-3 to the negative side of a low impedance, stable, 0.3 volt DC ±0.1% source. Connect the test probe tip to the positive side of the source. Adjust the DC calibration control (see Figure 6-1) for an indication of 0.3 volt on the black DC scale marked V.A.

g. All DC ranges and functions are now calibrated and should indicate proper values.

6.7.3 AC Volts Calibration

NOTE: Before proceeding with the AC voltage calibration, make certain that the DC calibration has been checked (refer to paragraph 6.7.2 above).

a. Set the function selector switch to the AC RMS/P-P position. Set the range switch to 0.3V position.

b. Set the switch on the test probe to the AC/OHMS/mA position.

c. Connect the ground lead of Model 313-3 to the ground side of a low impedance stable 0.3 volt AC ±0.25% sine wave source. Connect the tip of the test probe to the "high" side of the source.

d. Adjust the AC calibration control (see Figure 6-1) for an indication of 0.3 volt on the upper red scale (left side is marked AC).

e. All AC ranges are now calibrated and should indicate the correct values.

SECTION VII

ACCESSORY PROBES

7.1 GENERAL

This section contains the general description and technical data of the Simpson High Frequency Probe and the Simpson High Voltage Probe. These two probes expand the measuring and application capabilities of the Model 313-3, in a convenient manner and at a nominal cost.

7.2 HIGH FREQUENCY PROBE (Catalog No. 00191)

7.2.1 The Simpson High Frequency Probe, catalog number 00191, (Figure 7-1), extends the frequency measuring capabilities of the Model 313-3, up to 250 MHz. The probe cable is terminated with the same type connector as the test probe normally supplied with the Instrument.

7.2.2 The 00191 High Frequency Probe contains a crystal diode within the probe body which rectifies the voltage under test. This charges a 680 pF capacitor in direct proportion to the positive peak value of the voltage being measured. This peak voltage is applied to the DC input of the Instrument where it is read directly on the DC scale in terms of the rms value of the voltage at the probe input.

NOTE: The probe circuit works as a peak detector, and responds only to the positive peak value of a sinusoidal signal. Therefore, the rms indication is only accurate for sine wave signals.

7.2.3 Technical Data

The specifications for the 00191 High Frequency Probe are as follows:

Frequency Response	10kHz to 250 MHz within 1 dB
Probe Input Capacitance	2pF
Voltage Range	40 volts rms (maximum)
Probe Accuracy	±3% of full scale @ mid frequencies
Reading	rms value of sine wave
Maximum Input	DC + AC peak not to exceed 500V

7.2.4 Operation

The operating instructions for the 00191 probe are contained in the instruction sheet provided with the High Frequency Probe.

Figure 7-1. High Frequency Probe

7.3 DC HIGH VOLTAGE PROBE (Catalog No. 00192)

WARNING

The Simpson High Voltage Probe, Catalog No. 00192, (Figure 7-2) is intended for the measurement of high DC voltages in high impedance, low power capability circuits only as encountered in consumer type TV receivers. Do not make voltage measurements in excess of 30,000 volts DC. Read instructions carefully prior to making measurements.

7.3.1 The Simpson High Voltage Probe extends the DC voltage range of the Model 313-3 up to 30,000 volts DC. The primary purpose of the probe is to measure high voltages from direct current sources of very low power capacity, only as encountered in consumer type TV receivers. The probe body is made of high temperature polystyrene, and contains a high voltage precision resistor of high megohm value. The shield of the probe cable, and the internal probe shield, are connected to the outer shell of the cable BNC connector. Also the ground return lead which comes out from the rear of the probe. The ground return lead terminates with an insulated alligator clip. No additional leads are required. The 00192 probe can be used with the 0.3, 1, 3, 10 or 30V ranges of the Model 313-3.

7.3.2 Technical Data

The specifications for the 00192 DC High Voltage Probe are as follows:

Voltage Range:	0 to 30,000 VDC (max.)
Probe Input Resistance:	1091 Megohms
Accuracy (Input resistance):	±2%
Voltage Coefficient (Probe resistance):	−1.5 ppm per volt (max.)
Reference Conditions:	23°C, 30% to 60% relative humidity
Probe Output Resistance:	1.1 Megohm ±0.5%

7.3.3 Operation

The operating instructions for the 00192 probe are contained in the instruction sheet provided with the DC High Voltage Probe.

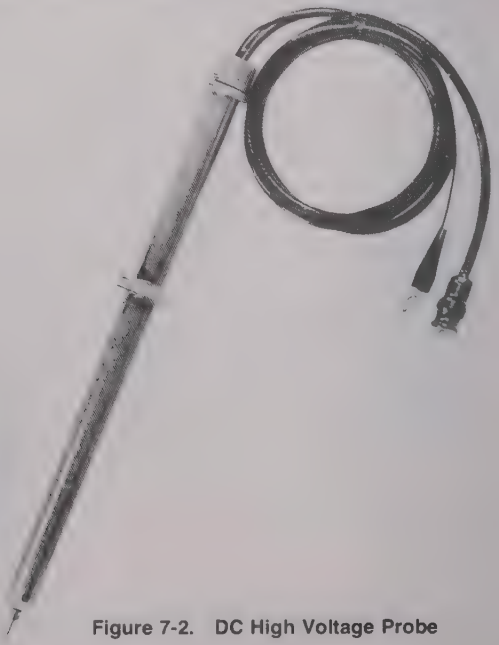


Figure 7-2. DC High Voltage Probe

SECTION VIII

ORDERING INFORMATION, SCHEMATIC AND AUTHORIZED SERVICE CENTERS

Table 8-1. Items Supplied With Instrument

Quantity	Description	Catalog Number
1	Test Probe with shielded cable having a BNC connector on one end and probe body with built-in DC/AC, OHMS, mA switch at the other end	00189
1	1.5 volt, D size cell NEDA 13*	*
1	9 volt battery, NEDA type 1600	5-112598
1	Operator's Manual	5-118394

*Available from local retail outlets. Refer to Table 1-1.

Table 8-2. Accessories

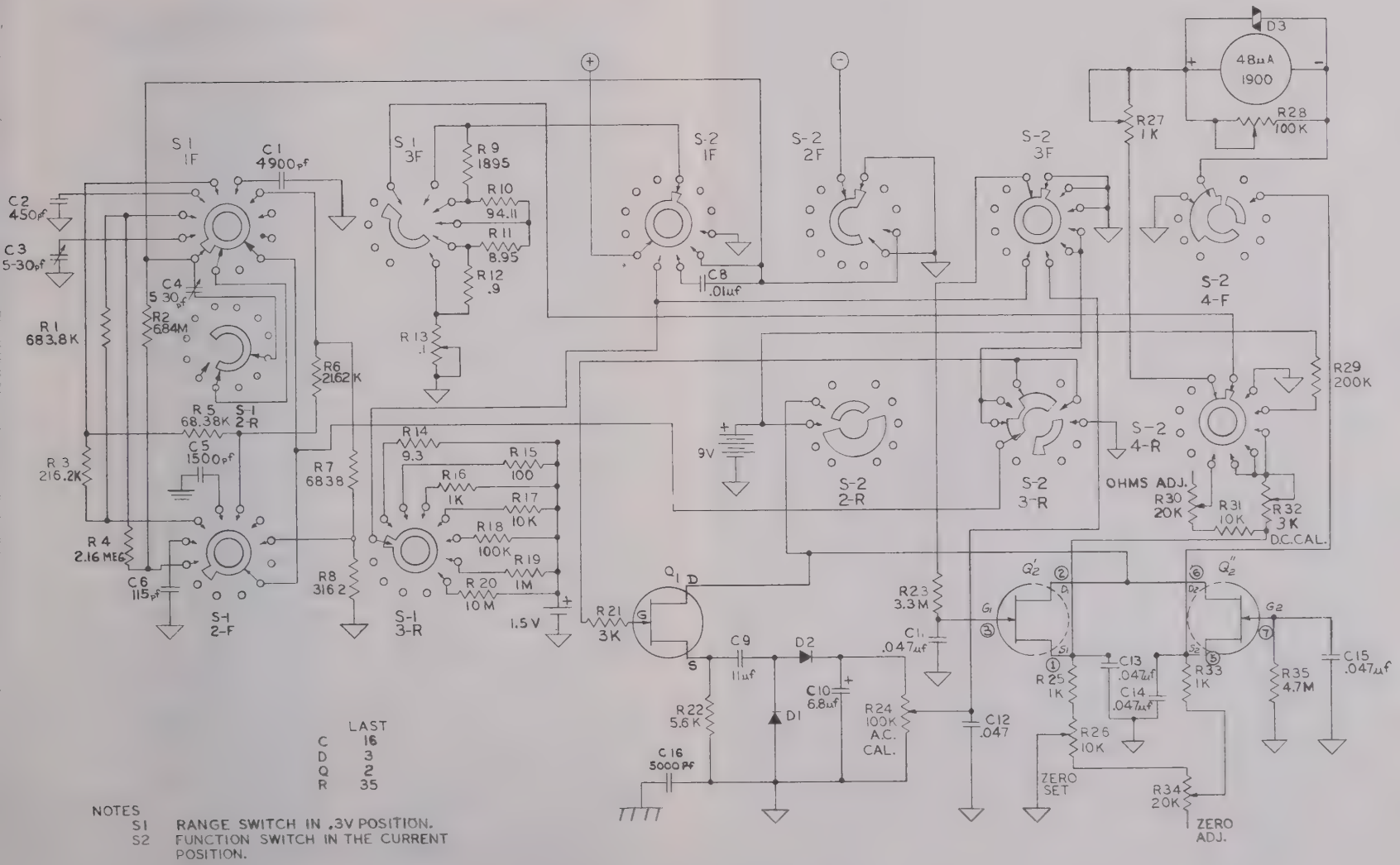
Description	Catalog Number
Carrying case, vinyl with test probe storage space	00577
High frequency probe	00191
DC high voltage probe	00192

Table 8-3. Replacement Parts

Symbol	Description	Catalog Number
C1	Capacitor, 4900 pf ±1%, 63VDC	5-114063
C2	Capacitor, 450 pf ±1%, 63VDC	5-114061
C3, C4	Capacitor Trimmer, 5-30 pF	5-115000
C5	Capacitor, 1500 pf ±1%, 25VDC	5-114062
C6	Capacitor, 115 pf ±1%, 160VDC	5-114060
C8	Capacitor, .01 μf, ±20%, 1.4KVDC	5-112541
C9	Capacitor, 11 μf, ±20%, 10VDC	5-112592
C10	Capacitor, 6.8 μf, ±20%, 20VDC	5-112593
C11, 12, 13, 14, 15	Capacitor, .047 μf, ±10%, 250VDC	5-112538
C16	Capacitor, 5000 pf, ±20%, 3KVDC	5-113760
D1, D2	Diode, Germanium, type D835-1	5-115392
D3	Varistor, Silicon	1-110670
Q1	Transistor, F.E.T., "N" Channel, MPF104	5-112747
Q2'-Q2"	Transistor, Dual Matched Pair, F.E.T., "N" Channel	5-113585
R1	Resistor, 683.8k Ω, ±1%, 1/2W	5-113126
R2	Resistor, 6.84MΩ, 1%, 1/2W	5-113124
R3	Resistor, 216.2kΩ, 1%, 1/2W	5-113122
R4	Resistor, 2.16MΩ, 1%, 1/2W	5-113125
R5	Resistor, 68.38kΩ, 1%, 1/2W	5-113123
R6	Resistor, 21.62kΩ, 1%, 1/2W	5-115320
R7	Resistor, 6.838kΩ, 1%, 1/2W	5-113136
R8	Resistor, 3.162kΩ, 1%, 1/2W	5-113127
R9	Resistor, 1.895kΩ, ±1%, bobbin	10-675320
R10	Resistor, 94.1Ω, ±1%, bobbin	10-675319
R11	Resistor, 8.95Ω, ±1%, bobbin	10-675318
R12	Resistor, .9Ω, ±1%, bobbin	10-675317
R13	Shunt, .1Ω, 1 Amp. Adjustable (approx. 0.1Ω)	10-650133
R14	Resistor, 9.3Ω, ±1%, bobbin	10-675322
R15	Resistor, 100Ω, 1%, 1/2W	5-113141

R16	Resistor, 1kΩ, 1%, 1/2W	1-114742
R17	Resistor, 10kΩ, 1%, 1/2W	1-114744
R18	Resistor, 100kΩ, 1%, 1/2W	5-113142
R19	Resistor, 1MΩ, 1%, 1/2W	5-113144
R20	Resistor, 10MΩ, 1%, 1/2W	1-113434
R21	Resistor, 3kΩ, ±5%, 1/2W	5-118682
R22	Resistor, 5.6kΩ, ±5%, 1/2W	5-118610
R23	Resistor, 3.3MΩ, ±5%, 1/2W	1-115947
R24, 28	Potentiometer, 100kΩ, ±30%, 1/4W	5-112605
R25, 33	Resistor, 1kΩ, ±5%, 1/2W	1-118602
R26	Potentiometer, 10kΩ, ±30%	5-112596
R27	Potentiometer, 1kΩ, ±30%, 1/4W	5-113504
R29	Resistor, 200kΩ, 1%, 1/2W	5-113143
R30, 34	Potentiometer, 20kΩ, ±30%	5-113138
R31	Resistor, 10kΩ, ±5%, 1/2W	1-118615
R32	Potentiometer, 3kΩ, ±30%, 1/4W	5-110714
R35	Resistor, 4.7MΩ, ±5%, 1/2W	5-112612
S1	Switch, 3 wafers, 8 positions (range)	5-115643
S2	Switch, 4 wafers, 7 positions (function)	5-115642
	Carrying handle assembly	10-861080
	Knob, range & function switch (Push-on type)	5-114800
	Knob, OHMS and ZERO ADJUST	5-115018
	Phenolic case assembly (includes handle assembly)	10-862062
	Cover, Case, Battery Compartment	3-260615

NOTES



	LAST
C	16
D	3
Q	2
R	35

NOTES

S1 RANGE SWITCH IN .3V POSITION.

S2 FUNCTION SWITCH IN THE CURRENT POSITION.

Figure 8-1. Model 313-3 Schematic Diagram

AUTHORIZED SERVICE CENTERS

SIMPSON ELECTRIC COMPANY

853 Dundee Avenue, Elgin, Illinois 60120 — Phone: (312) 697-2260

★Parts Sales & Repair Service Only

★★Parts, General Test Equipment & Panel Instrument Sales & Service

★★★Same Service As (★★) Above Plus Panel Instrument Modification

☐ Additionally Authorized for Service on Recorders, Controllers, Digital Products and Lab Portables

★★★ALABAMA, MOBILE 36617
BROWNELL-ELECTRO INC.
3450 Armour Drive
Tel. 205/479-8581

★ALASKA, ANCHORAGE 99501
YUKON RADIO SUPPLY, INC.
3222 Commercial Drive
P.O. Box 406
Tel. 907/277-1497

★ALASKA, ANCHORAGE 99500
R. M. ZOOK & ASSOCIATES
1710 E. 27th Avenue
Tel. 907/272-6917

★ALASKA, FAIRBANKS 99701
YUKON RADIO SUPPLY, INC.
1112 Cushman Street
Tel. 907/452-1011

★★★ARIZONA, PHOENIX 85040
☐ METERMASTER INC.
4132 E. Wood St.
Tel. 602/243-4111

★★CALIFORNIA, LOS ANGELES 90040
☐ E.I.L. INSTRUMENTS INC.
6212 Peachtree St.
Tel. 213/685-7020

★★★CALIFORNIA, GLENDALE 91201
☐ WEATHERFORD INSTRUMENT DIV.
WESTERN ELECTRONIC SUPPLY CORP.
640 Allen Street
Tel. 213/246-4861

★★★CALIFORNIA, LOS ANGELES 90040
☐ METERMASTER, INC.
5646 Jillson Street
Tel. 213/685-4340

★★★CALIFORNIA, PALO ALTO 94303
☐ METERMASTER, INC.
3995 E. Bayshore Road
Tel. 415/968-0313

★★★CALIFORNIA, SAN DIEGO 92123
☐ METERMASTER/SAN DIEGO
8799 Balboa Avenue
Tel. 714/560-4841

★★★CALIFORNIA, SAN FRANCISCO 94105
PACIFIC ELECTRICAL
INSTRUMENT LAB
150 Folsom
Tel. 415/543-3104

★★★CALIFORNIA, SANTA CLARA 95050
☐ DYNAMETRON
2000 De La Cruz Blvd.
Tel. 408/246-6535

★CALIFORNIA, SOUTH PASADENA 91030
ETALON COMPANY
1323 Huntington Drive
Tel. 213/257-5410

★★★COLORADO, DENVER 80223
☐ METER MASTER INSTRUMENT
CORPORATION
1165 S. Cherokee
Tel. 303/722-5766

★★★CONNECTICUT, MIDDLETOWN 06457
☐ THE MANCIB COMPANY
Randolph Road and Coe
Tel. 203/346-6646

★★FLORIDA, MIAMI 33136
FLORIDA PRECISION INSTRUMENT
COMPANY
800 N.W. 7th Avenue
Tel. 305/324-1731

★★★FLORIDA, MIAMI 33142
☐ KIMBALL ELECTRONIC LAB., INC.
3620 N.W. 48 Terrace
Tel. 305/635-9712

★★★FLORIDA, ORLANDO 32806
☐ BROWNELL-ELECTRO INC.
307 27th St., Box 8945
Tel. 305/843-6775

★★FLORIDA, TAMPA 33614
TAMPA INSTRUMENTATION CENTER
A.C. FERNANDEZ ELECTRIC
4807 N. Church Avenue
Tel. 813/870-0183

★★★GEORGIA, ATLANTA 30354
☐ BROWNELL-ELECTRO INC.
3020 Commerce Way
Tel. 404/762-5181

★★**HAWAII, HONOLULU 96819**
EMC CORPORATION
2979 Ualena Street
Tel. 808/847-1138

★★**HAWAII, HONOLULU 96819**
KEMS INCORPORATED
239 Puuhale Road
Tel. 808/847-1395

★★★**ILLINOIS, BRIDGEVIEW 60455**
E.I.L. INSTRUMENTS, INC.
9708 Industrial Drive
Tel. 312/430-2292

★★★**ILLINOIS, ELK GROVE VILLAGE 60007**
METERMASTER, INC.
121 Gordon Street
Tel. 312/593-8650

★★★**ILLINOIS, OAK PARK 60302**
PACIFIC INDICATOR COMPANY
6603 W. North Avenue
Tel. 312/261-1330

★★★**ILLINOIS, ROCKFORD 61108**
☐ ROCKFORD INSTRUMENTS LAB.
1718 Broadway
Tel. 815/397-1004

★★★**INDIANA, EVANSVILLE 47712**
☐ ELECTRO-LAB SERVICES INC.
510 Williams Road
Tel. 812/423-5211

★★**KANSAS, OVERLAND PARK 66206**
BROOKS ELECTRONICS INC.
3761 W. 95th Street
Tel. 913/648-3131

★★★**KANSAS, WICHITA 67211**
☐ MAIN ELECTRONICS INC.
225 Ida
Tel. 316/267-3581

★★★**LOUISIANA, HARAHAN 70123**
☐ INDUSTRIAL INSTRUMENT WORKS
134 Laitram Lane
Tel. 504/733-8355

★★★**MARYLAND, ELKRIDGE 21227**
☐ SUNSHINE SCIENTIFIC INSTRUMENTS, INC.
5800 Main Street
Tel. 301/796-5600

★★★**MARYLAND, GAITHERSBURG 20760**
☐ PIONEER/INSTRUMENTATION
Div. of Pioneer Standard Electronics Inc.
9100 Gaither Road
Tel. 301/948-0710

★★★**MARYLAND, SAVAGE 20863**
☐ INSTRUMENT SPECIALTIES INC.
Div. of Pyttronic Ind.
8220 Wellmoor Court
Tel. 301/792-0780

★★★**MARYLAND, TIMONIUM 21093**
☐ E.I.L. INSTRUMENTS, INC.
1830 York Road
Tel. 301/252-1260

★★**MASSACHUSETTS, BILLERICA 01821**
METERMASTER, INC.
13 Fortune Drive
Tel. 617/677-8346

★★★**MASSACHUSETTS, BURLINGTON 01803**
☐ THE MANCIB COMPANY
Subsidiary of E.I.L. Instruments Inc.
21 "A" Street
Tel. 617/272-9450

★★★**MICHIGAN, FERNDALE 48220**
☐ RAM METER, INC.
1100 Hilton Road
Tel. 313/398-6767

★★★**MINNESOTA, MINNEAPOLIS 55427**
☐ INSTRUMENTATION SERVICES INC.
957 Winnetka Avenue North
Tel. 612/544-8916

★★★**MISSOURI, ST. LOUIS 63108**
☐ INDUSTRIAL SERVICE LABORATORIES CORP.
4354 Olive Street
Tel. 314/535-5760

★★★**MISSOURI, ST. LOUIS 63143**
☐ SCHERRER INSTRUMENTS INC.
7170 Manchester
Tel. 314/644-5362

★★**MONTANA, BILLINGS 59102**
INDUSTRIAL ELECTRONICS & AUTOMATION COMPANY
2500 Grand Avenue
Tel. 406/656-1313

★★**NEBRASKA, LINCOLN 68508**
ELECTROMETRICS COMPANY
404 South 11th
Tel. 402/477-3434

★★★**NEW HAMPSHIRE, PORTSMOUTH 03801**
A & M INSTRUMENTS INC./N.E.
1039 Islington Street
Tel. 603/431-7912

★★★**NEW JERSEY, BELLEVILLE 07109**
MARSHALL INSTRUMENTS INC.
236 Washington Avenue
Tel. 201/751-1190

★★★**NEW JERSEY, SOUTH PLAINFIELD 07080**
BROWNELL-ELECTRO INC.
500 Hadley Road
Tel. 201/753-4600

★★★**NEW YORK, CHADWICKS 13319**
MOHAWK COMMUNICATIONS
3500 Bleachery Pl.
Tel. 315/737-7328

★★★**NEW YORK, CLARENCE 14031**
☐ TROTT ELECTRONICS INC.
9020 Wehrle Drive
Tel. 716/634-8500

★★★**NEW YORK, NEW YORK 10011**
BROWNELL-ELECTRO INC.
85 Tenth Avenue
Tel. 212/924-6000

★★★**NEW YORK, NEW YORK 10011**
☐ NILSSON ELECTRICAL LABORATORY, INC.
111 8th Avenue — Rm. 1525
Tel. 212/675-7944

★★★**NORTH CAROLINA, CHARLOTTE 28216**
☐ BROWNELL-ELECTRO INC.
5141 Belhaven Blvd.
Box #16368
Tel. 704/394-4341

★★★**OHIO, CLEVELAND 44105**
☐ PIONEER/INSTRUMENTATION
INSTRUMENT LABORATORY
Div. of Pioneer-Standard Electronics, Inc.
4800 East 131st Street
Tel. 216/587-3600

★★★**OHIO, CLEVELAND 44135**
☐ WESCHLER ELECTRIC CORP.
4250 West 130th Street
Tel. 216/251-4606

★★**OHIO, COLUMBUS 43214**
CONTRONICS, INC.
4800 Indianola Avenue
Tel. 614/846-5930

★★★**OHIO, DAYTON 45404**
☐ PIONEER/DAYTON
Div. of Pioneer-Standard Electronics, Inc.
1900 Troy Street
Tel. 513/236-9900

★**OKLAHOMA, OKLAHOMA CITY 73107**
HUSTON LABORATORIES, INC.
536 No. Pennsylvania
Tel. 405/235-5469

★**OKLAHOMA, TULSA 74120**
AGRA ENGINEERING COMPANY
551 S. Quaker Avenue
Tel. 918/584-4235

★★★**OREGON, PORTLAND 97217**
☐ WESTCON, INC.
5101 N. Interstate
Tel. 503/283-0132

★★★**PENNSYLVANIA, PHILADELPHIA 19115**
☐ SUNSHINE SCIENTIFIC
INSTRUMENTS INC.
1810 Grant Avenue
Tel. 215/673-5600

★★★**PENNSYLVANIA, PITTSBURGH 15238**
CAM/RPC
620 Alpha Drive RIDC Pk.
Tel. 412/782-3770

★★★**PENNSYLVANIA, PITTSBURGH 15221**
☐ E.I.L. INSTRUMENTS, INC.
1844 Ardmore Blvd.
Tel. 412/731-5230

★★★**TENNESSEE, MEMPHIS 38116**
☐ BROWNELL-ELECTRO INC.
3053 Tranquility Drive
Tel. 901/332-9258

★★**TENNESSEE, MEMPHIS 38104**
INSTRUMENT REPAIR SERVICE
468 N. Watkins
Tel. 901/278-0762

★★★**TENNESSEE, NASHVILLE 37210**
☐ BROWNELL-ELECTRO INC.
1050 Acorn Drive
Tel. 615/889-8230

★★★**TEXAS, DALLAS 75220**
☐ ULTRA INSTRUMENT LAB., INC.
9995 Monroe
Tel. 214/357-0297

★★★**TEXAS, EL PASO 79901**
BORDER ELECTRONICS
1704 E. Paisano Drive
Tel. 915/532-2524

★★★**TEXAS, GARLAND 75040**
METERMASTER, INC.
2809 National Drive
Tel. 214/271-5671

★★★**TEXAS, HOUSTON 77006**
☐ ELECTRICAL INSTRUMENT METER
COMPANY (EIMCO)
1424 Westheimer
Tel. 713/526-6871 & 72

★★★**TEXAS, HOUSTON 77023**
☐ METERS & INSTRUMENTS CORP.
6428 Gulf Freeway
Tel. 713/644-1631

★★**TEXAS, ODESSA 79760**
METER SERVICE & SUPPLY
2127 Kermit Highway
P.O. Box 2373
Tel. 915/332-0565

★★★**TEXAS, ODESSA 79760**
☐ WHITLOCK INSTRUMENT
1306 North Texas
Tel. 915/337-3412

★★★**VIRGINIA, ALEXANDRIA 22312**
☐ E.I.L. INSTRUMENTS, INC.
5400 Cherokee Avenue
Tel. 703/354-4330

★★★**VIRGINIA, CHESAPEAKE 23325**
☐ INSTRUMENT TECHNICAL REP.
1835 Lockhard Street
Tel. 804/424-5121

★★★**VIRGINIA, RICHMOND 23234†**

★★★**VIRGINIA, CHESTERFIELD 23831††**
☐ INSTRUMENT TECHNICAL
REPRESENTATIVES
7400 White Pine Road
Tel. 804/275-1431

★★★**WASHINGTON, SEATTLE 98105**
☐ EICHER-RICHARDS COMPANY
2727 N.E. Blakeley Street
Tel. 206/523-7888

★★★**WASHINGTON, BELLEVUE 98009**
I.L.I.
13215 S.E. 30th
P.O. Box 3097
Tel. 206/747-9410

★★**WASHINGTON, SPOKANE 99202**
BLACKS-INDUSTRIAL INC.
N. 401 Helena
P.O. Box 3286
Tel. 509/535-1504

★★★**WISCONSIN, MILWAUKEE 53202**
THE ELECTRO MECHANO COMPANY
241 East Erie Street
Tel. 414/272-4050

★★**WYOMING, LANDER 82520**
SIMMONS ELECTRIC INC.
Rt. 61 — P.O. Box 595
Tel. 307/332-9711

---

† *Regular Mail Delivery*
†† *UPS Delivery*

Quality is the indispensable component
of every Simpson instrument . . . . . .